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AN ANALYSIS OF THE AUSTRALIAN GRASS FLORA

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Summary

The grass flora of Australia is analysed by several different methods complemented by 6 figures and 15 tables. Native and naturalized exotic entities are given equal treatment and comparisons between the floras of each state are enumerated. Taxonomic breakdowns and comparisons for each state are given at tribal and informal sub-family groupings. Reasons are suggested for the data where possible.

The recently published check-list of Australian grasses (Simon, 1978) provided an incentive to analyse the data in this list along the lines outlined by a recent analysis of the flora of Victoria (Ross, 1976). Although the distributional data in the check-list is given on a state basis, it is realized that a more meaningful analysis would have been obtained had the geographical areas been based on the lines of topography, vegetation types, climate, soils and other general ecological factors as has been recently attempted at generic rank (Clifford & Simon, 1981). However, although political boundaries are in most cases artificial they are unambiguous, and are considered useful demarcations for the present analysis to be undertaken.

The check-list deals only with Australian native and naturalized grasses, although distribution of these grasses into New Guinea was also indicated in the check-list.

TABLE 3: Proportional representation of the grass flora of each state and of Australia. (Figures shown as native taxa/naturalized exotic taxa).

	Tribes	Genera	Entities
N.S.W.	26(21/5)	149(98/51)	636(418/218)
Vic.	24(19/5)	111(60/51)	382(229/153)
Tas.	21(16/5)	75(35/40)	239(121/118)
N.T.	24(23/1)	99(92/7)	462(419/43)
S.A.	21(17/4)	114(69/45)	352(232/120)
W.A.	24(20/4)	138(91/47)	541(373/168)
Qld.	28(25/3)	155(124/31)	779(610/169)
Australia	33(27/6)	209(148/61)	1299(976/323)

The proportional representation of the grass flora of each state (Table 3) reveals Queensland to have the richest flora at tribal, generic and entity* rank. In terms of the representation of the native flora Queensland again rates highest at tribal, generic and entity rank. The naturalized exotic flora are best represented in New South Wales, Victoria and Tasmania at tribal rank, in New South Wales and Victoria at generic rank and in New South Wales at entity rank. However, in terms of the proportion of naturalized exotics to natives, Tasmania has the highest proportion at tribal, generic and entity rank with the Northern Territory having the lowest. Table 4 shows these proportions in terms of percentage for entities and also shows the percentage of the Australian total for the native and naturalized exotic entities. From the figures it is seen that Queensland is best represented in terms of the native flora and New South Wales in terms of the exotic flora, with Tasmania and the Northern Territory rating last in terms of the native and exotic flora, respectively.

* Throughout this paper the term entity is used to include both species and infra-specific taxa as I consider the placing of a taxon at a particular rank to be arbitrary for the purpose of a broad floristic analysis such as this.

TABLE 4: Percentage of native and naturalized exotic entities in each state, and Australia and percentage of the Australian total of native and naturalized entities for each state.

	% native	% naturalized	% of Australian natives	% of Australian naturalized exotics
N.S.W.	65.8	34.2	42.7	67.7
Vic.	59.9	40.1	23.4	47.5
Tas.	50.6	49.4	12.4	36.6
N.T.	90.7	9.3	42.8	13.4
S.A.	65.9	34.1	23.7	37.3
W.A.	68.9	31.1	38.1	52.2
Qld.	78.3	21.7	62.4	52.5
Australia	75.2	24.8		

When the density of grasses for each state is examined (Table 5) it is seen there is almost an inverse correlation between size of area under consideration and density, the smaller the area the greater the density. The relationship between area and species number is always of this pattern (Williams, 1964) and a more meaningful interpetation on flora richness is obtained when entity number is plotted against area (Figs 17 and 18), with both the numbers and areas on a logarithmic scale. A straight line of best fit shows the mean measure of 'flora richness' for the whole country and the value for each state can be assessed with relation to this line. Plots are given for both the total (Fig. 17) and native (Fig. 18) floras and from them it can be seen how similar the two graphs are and deduced that when the exotic flora is added to the native flora the richness of the flora is increased proportionately for each state. The one exception is the Northern Territory where the value lies above the mean value for the native grasses but below for all the grasses. This is because of the low number of exotics in the Northern Territory in relation to the relatively high number in the other states. In general Queensland and New South Wales have rich floras relative to their size, Northern Territory, Victoria and Tasmania floras of average richness, and the floras of Western Australia and South Australia are relatively poor. Queensland and New South Wales owe their richness to both states having good seasonal rainfall with the area in common to both (the MacPherson-Macleay the overlap) (Burbidge, 1960) receiving rain at all times of the year. The paucity of the Western Australian and South Australian grass floras is directly correlated to the low average rainfall for each state and the corresponding large areas of desert.

TABLE 5: Density of grass entities for each state and Australia (Figures given for native and for all entities)

	Area (km^2)	No. of entities (Native)	Density (entities/ 10,000 km^2)	No. of entities (All)	Density (entities/ 10,000 km^2)
N.S.W.	804,000	418	5.2	636	7.9
Vic.	227,600	229	10.1	382	16.8
Tas.	67,800	121	17.8	239	35.3
N.T.	1,346,200	419	3.1	462	3.4
S.A.	984,000	232	2.4	352	3.6
W.A.	2,525,500	373	1.5	541	2.1
Qld.	1,727,200	610	3.5	779	4.5
Australia	7,682,300	976	1.3	1299	1.7

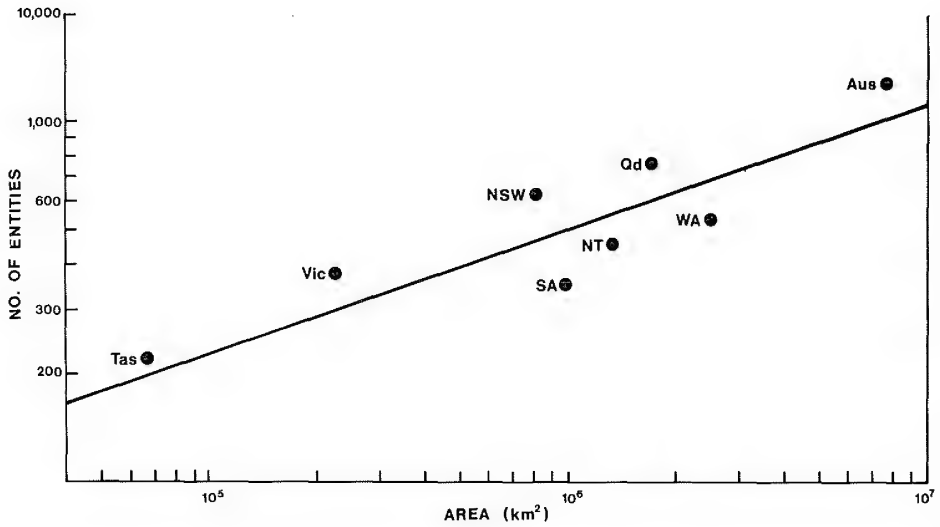

Figure 17 Relation between area and number of entities (native and naturalized exotic), each on a log. scale, in Australian states.

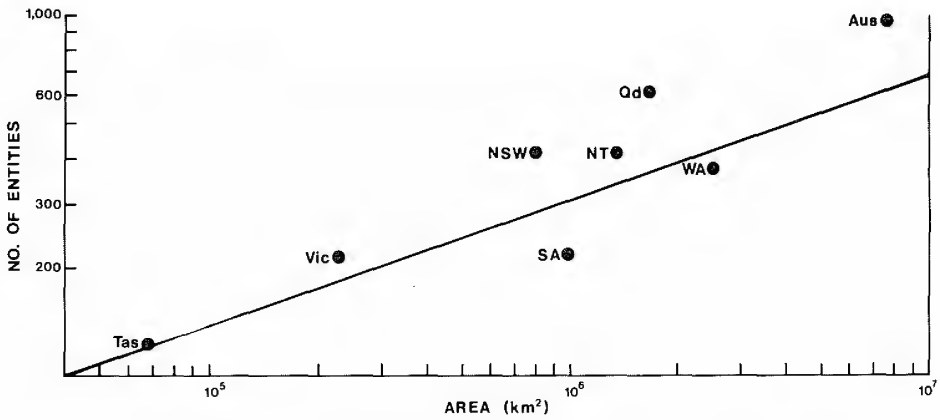

Figure 18. Relation between area and native entities, each on a log. scale, in Australian states.

Tables 6 and 7 show a comparison between the floras of the Australian states with respect to each other, Table 6 giving the number of entities in common between the states and Table 7 transposing these values to a Czekanowski Coefficient of similarity (Czekanowski, 1913). Three values are given in each comparison, one for native entities, one for naturalized exotic entities and one for all entities. Fig. 19 shows the coefficients of the total floras arranged in decreasing order together with the values for the natives and naturalized exotics arranged in the same order. In terms of the total and native values the highest eight values are for states adjacent to each other, six of them being wholly or partially within temperate to subtropical latitudes and two being wholly or partially in tropical latitudes. The high figures for the temperature to subtropical adjacent states are due mainly to the large naturalized exotic component of the floras whereas the high correlation between the adjacent tropical

states (Qld. — N.T.; N.T. — W.A.) can be attributed mainly to the native component. In general the greater the latitude between states the larger the difference between the floras whereas those of a similar latitude show a closer correlation even though they may not have a common border. An example of these two correlations is shown by the low correlation between the Northern Territory and adjacent South Australia compared to the fairly high correlation between non-adjacent Queensland and Western Australia. Another generalization from Fig. 19 is that whenever the native coefficient is above the value for the total flora the naturalized exotic component is below the total value and vice versa.

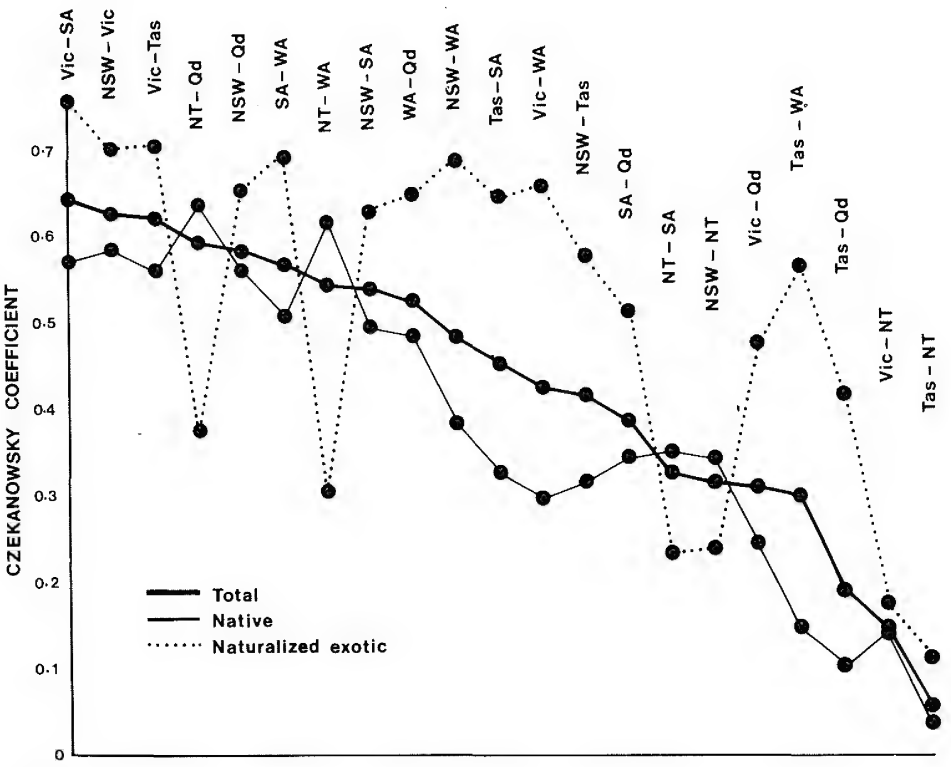

Figure 19. Coefficients of similarity (Czekanowski) of the grass floras of Australian states with respect to each other.

The nature of both endemic and widespread distribution of entities is revealed by the examination of Tables 8 and 9. In terms of total number, Queensland has by far the largest number of endemics due to a large native component and rivals Western Australia in the percentage representation of the total number of endemics*. In terms of the native flora alone however, Western Australia has the highest percentage of endemic entities.

* When the term endemic is applied to naturalized exotic entities endemism is considered only with respect to the geographical areas under consideration in this paper, as an entity being a naturalized exotic naturally implies its native occurrence is geographically outside the area discussed in this paper.

TABLE 6: Number of entities in common between Australian states.

	N.S.W.	Vic.	Tas.	N.T.	S.A.	W.A.
Vict.	188 *130* 318					
Tas.	85 *97* 183	98 *95* 193				
N.T.	143 *31* 174	46 *17* 63	10 *9* 19			
S.A.	161 *106* 267	132 *103* 235	57 *77* 134	114 *19* 133		
W.A.	151 *132* 283	90 *105* 195	36 *81* 117	243 *32* 274	154 *100* 254	
Qld.	288 *126* 414	103 *77* 180	38 *60* 98	327 *40* 367	144 *74* 218	237 *109* 346

Normal Print = Native
Italic Print = Naturalized Exotic
Underlined Print = Total

When widespread entities are considered (Table 9) only longitudinal spread is examined as it was previously shown there is little merging of the temperate and tropical flora in terms of floristic composition. Widespread entities within temperate Australia are considered with and without the inclusion of Tasmania. It is seen that there is a far higher correlation between the floras of the tropical areas than those of the temperate areas, particularly of the native flora where 21.5 percent of the entities have a widespread distribution in a band across tropical Australia. This contrasts with a low 3.2 percent of the natives being widespread in temperate Australia, including Tasmania. Such a disjunction in the south is due to the Miocene marine incursion in the Nullabor region, whereas no such barrier existed in the north (Laseron, 1955). When the naturalized exotic widespread entities are examined the converse situation exists with 21.1 percent being widespread in the south (over half if Tasmania is excluded) and only 10 percent in the north. This can be attributed directly to man-induced pasture introductions having been far more active in temperate than tropical Australia.

Tables 10 to 13 and Figs 20 to 22 give a taxonomic break-up of the entities for each state and Australia. Tables 10 and 11 deal with the entities grouped into the tribes used in the check-list, Table 10 giving the actual entity number and Table 11 giving the conversion of these numbers to percentages. Due to the conflicting nature of contemporary grass classification at a tribal level (Prat, 1960; Pilger, 1954; Hubbard, 1973) it was thought that graphic representation of taxonomic divisions would

be more meaningful if more loosely defined taxonomic groupings along the lines demarcated by Clifford and Watson (1977) were used. The groupings used differ slightly from those of Clifford and Watson and are given in Table 14. The actual entity number for these groupings are shown in Table 12, with Table 13 giving the percentages and Figs 20 to 22 giving the diagrammatic representation of these percentages.

TABLE 7: Coefficients of similarity (Czekanowski) of the grass floras of Australian states.

	N.S.W.	Vic.	Tas.	N.T.	S.A.	W.A.
Vic.	.581 *.700* .625					
Tas.	.315 *.577* .416	.560 *.701* .622				
N.T.	.342 *.238* .317	.142 *.174* .149	.037 *.112* .054			
S.A.	.495 *.627* .541	.573 *.755* .640	.323 *.647* .454	.350 *.233* .327		
W.A.	.382 *.684* .481	.299 *.654* .423	.146 *.566* .300	.614 *.303* .548	.509 *.694* .569	
Qld.	.560 *.651* .585	.245 *.478* .310	.104 *.418* .192	.635 *.377* .591	.342 *.512* .385	.482 *.647* .524

Normal Print = Native
Italic Print = Naturalized Exotic
Underlined Print = Total

TABLE 8: Endemic entities of each Australian state

	Natives	Naturalized exotics	Total	% Natives	% Naturalized exotics	% Total
N.S.W.	38	28	66	9.1	12.8	10.4
Vic.	7	11	18	3.1	7.2	4.7
Tas.	19	12	31	15.7	10.2	13.0
N.T.	55	1	56	13.1	2.3	12.1
S.A.	16	3	19	6.9	2.5	5.4
W.A.	66	19	85	17.7	11.3	15.7
Qld.	99	23	122	16.2	13.6	15.7

TABLE 9: Widespread entities in Tropical and Temperate Australia

		Natives	Naturalised exotics	Total	% Australian natives	% Australian naturalized exotics
Tropical	W.A. - N.T. - Qld.	210	32	242	21.5	10.0
Temperate	N.S.W. - Vic. - Tas. - S.A. - W.A.	31	68	99	3.2	21.1
	N.S.W. - Vic. - S.A. - W.A.	76	90	166	7.8	51.6

TABLE 10: Numbers of entities in each State and Australia grouped according to tribe. (Figures shown as native entities/naturalized exotic entities).

	N.S.W.	Vic.	Tas.	N.T.	S.A.	W.A.	Qld.	Australia
Agrostideae	59/13	41/15	34/14	1/0	17/12	14/15	16/7	76/21
Andropogoneae	36/10	10/1	4/0	84/4	16/2	56/9	112/14	129/18
Aristideae	31/0	3/0	0/0	31/0	9/0	15/0	61/0	66/0
Arundineae	1/2	1/1	1/2	2/0	2/2	2/2	2/1	2/3
Arundinelleae	1/0	0/0	0/0	2/0	0/0	1/0	4/0	4/0
Aveneae	6/19	5/20	4/16	0/1	3/12	1/18	2/9	8/27
Bambuseae	0/1	0/0	0/0	1/0	0/0	0/0	2/0	3/1
Brachypodieae	0/1	0/1	0/2	0/0	0/1	0/1	0/0	0/2
Bromeae	1/20	1/13	1/9	0/1	1/7	1/7	1/7	1/23
Centosteceae	0/0	0/0	0/0	0/0	0/0	0/0	3/0	3/0
Chlorideae	14/5	5/2	1/0	19/5	10/2	16/4	26/7	30/10
Danthonieae	40/2	33/3	23/1	44/0	27/4	49/4	43/0	107/5
Ehrharteae	0/4	0/4	0/2	0/0	0/4	0/7	0/2	0/8
Eragostideae	45/15	17/4	2/2	90/6	35/7	78/4	103/14	157/13
Garnotieae	0/0	0/0	0/0	0/0	0/0	0/0	1/0	1/0
Isachneae	1/0	1/0	0/0	5/0	1/0	0/0	4/0	5/0
Leptureae	0/0	0/0	0/0	2/0	0/0	0/0	3/0	4/0
Maydeae	1/1	0/0	0/0	2/0	0/0	3/0	3/0	3/1
Melinideae	0/2	0/1	0/0	0/1	0/0	0/2	0/2	0/2
Micraireae	0/0	0/0	0/0	7/0	0/0	0/0	1/0	8/0
Monermeae	0/4	0/4	0/2	0/0	0/4	0/2	0/0	0/5
Nardeae	0/0	0/0	0/1	0/0	0/0	0/0	0/0	0/1
Oryzeae	2/1	0/1	0/0	3/1	0/0	1/1	3/1	4/2
Paniceae	91/60	25/25	5/14	97/20	37/20	73/46	163/68	188/85
Pappophoreae	9/0	2/0	0/0	15/0	8/0	10/0	17/0	20/0
Phalarideae	6/9	8/7	11/7	0/0	2/5	2/8	3/7	15/10
Phareae	0/0	0/0	0/0	0/0	0/0	0/0	1/0	1/0
Poeae	34/31	37/32	18/29	0/2	17/27	12/27	6/20	55/45
Spartineae	0/0	0/2	0/2	0/0	0/1	0/0	0/0	0/3
Sporoboleae	9/2	4/1	1/1	9/0	7/1	6/2	15/3	16/5
Stipeae	24/5	30/3	11/2	3/0	36/1	30/1	8/0	62/5
Triticeae	4/11	3/13	3/12	0/2	1/8	1/8	3/7	4/20
Zoysieae	3/0	3/0	2/0	2/0	3/0	2/0	4/0	4/0
TOTAL	418/218	229/153	121/118	419/43	232/120	373/168	610/169	976/315

TABLE 11: Percentage representation in each State and Australia of the entities (grouped according to tribe), expressed as a percentage of the total for the state or country. (Figures shown as native entities/naturalized exotic entities).

	N.S.W.	Vic.	Tas.	N.T.	S.A.	W.A.	Qld.	Australia
Agrostideae	14.1/6.0	17.9/9.8	28.1/11.9	0.2/0	7.2/10.0	3.8/8.9	2.6/4.1	7.8/6.7
Andropogoneae	8.6/4.6	4.4/0.7	3.3/0	20.0/9.3	6.9/1.7	15.0/5.4	18.4/8.3	13.2/5.7
Aristideae	7.4/0	1.3/0	0/0	7.4/0	3.9/0	4.0/0	10.0/0	6.8/0
Arundineae	0.2/0.9	0.4/0.7	0.8/1.7	0.5/0	0.9/1.7	0.5/1.2	0.3/0.6	0.2/1.0
Arundinelleae	0.2/0	0/0	0/0	0.5/0	0/0	0.3/0	0.7/0	0.4/0
Aveneae	1.4/8.7	2.2/13.1	3.3/13.6	0/2.3	1.3/10.0	0.3/10.7	0.3/5.3	0.8/8.6
Bambuseae	0/0.5	0/0	0/0	0.2/0	0/0	0/0	0.3/0	0.3/0.3
Brachypodieae	0/0.5	0/0.7	0/1.7	0/0	0/0.8	0/0.6	0/0	0/0.6
Bromeae	0.2/9.2	0.4/8.5	0.8/7.6	0/2.3	0.4/5.8	0.3/4.2	0.2/4.1	0.1/7.3
Centosteceae	0/0	0/0	0/0	0/0	0/0	0/0	0.5/0	0.3/0
Chlorideae	3.3/2.3	2.2/1.3	0.8/0	4.5/11.6	4.3/1.7	4.3/2.4	4.3/4.1	3.1/3.2
Danthonieae	9.6/0.9	14.4/2.0	19.0/0.8	10.5/0	11.6/3.3	13.1/2.4	7.1/0	11.0/1.6
Ehrharteae	0/1.8	0/2.6	0/1.7	0/0	0/3.3	0/4.2	0/1.2	0/2.5
Eragrostideae	10.8/6.9	7.4/2.6	1.7/1.7	21.5/14.0	14.7/5.8	20.9/2.4	16.9/8.3	16.1/4.1
Garnotieae	0/0	0/0	0/0	0/0	0/0	0/0	0.2/0	0.1/0
Isachneae	0.2/0	0.4/0	0/0	1.2/0	0.4/0	0/0	0.7/0	0.5/0
Leptureae	0/0	0/0	0/0	0.5/0	0/0	0/0	0.5/0	0.4/0
Maydeae	0.2/0.5	0/0	0/0	0.5/0	0/0	0.8/0	0.5/0.3	0.3/0.3
Melinideae	0/0.9	0/0.7	0/0	0/2.3	0/0	0/1.2	0/1.2	0/0.6
Micraireae	0/0	0/0	0/0	1.7/0	0/0	0/0	0.2/0	0.8/0
Monermeae	0/1.8	0/2.6	0/1.7	0/0	0/3.3	0/1.2	0/0	0/1.6
Nardeae	0/0	0/0	0/0.8	0/0	0/0	0/0	0/0	0/0.3
Oryzeae	0.5/0.5	0/0.7	0/0	0.7/2.3	0/0	0.3/0.6	0.5/0.6	0.4/0.6
Paniceae	21.8/27.5	10.9/16.3	4.1/11.9	23.2/46.5	15.9/16.7	19.6/27.4	26.7/40.2	19.3/27.0
Pappophoreae	2.2/0	0.9/0	0/0	3.6/0	3.5/0	2.7/0	2.8/0	2.1/0
Phalarideae	1.4/4.1	3.5/4.6	9.1/5.9	0/0	0.9/4.2	0.5/4.8	0.5/4.1	1.5/3.2
Phareae	0/0	0/0	0/0	0/0	0/0	0/0	0.2/0	0.1/0
Poeae	8.1/14.2	16.2/20.9	14.9/24.6	0/4.6	7.3/22.5	3.2/16.1	1.0/11.8	5.6/14.3
Spartineae	0/0	0/1.3	0/1.7	0/0	0/0.8	0/0	0/0	0/1.0
Sporoboleae	2.2/0.9	1.7/0.7	0.8/0.8	2.1/0	3.0/0.8	1.6/1.2	2.5/1.8	1.6/1.6
Stipeae	5.7/2.3	13.1/2.0	9.1/1.7	0.7/0	15.5/0.8	8.0/0.6	1.6/0	6.4/1.6
Triticeae	1.0/5.0	1.3/8.5	2.5/10.2	0/4.6	0.4/6.7	0.3/4.8	0.5/4.1	0.4/6.3
Zoysieae	0.7/0	1.3/0	1.7/0	0.5/0	1.3/0	0.5/0	0.7/0	0.4/0
Total	100/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100

In each of the diagrams the taxonomic groupings are placed in the same order starting at a line running due east from the centre of the circle and proceeding segmentally in an anti-clockwise direction in the sequence pooid, andropogonoid, panicoid (strictly eu-panicoid), aristidoid, chloridoid, arundinoid, bambusoid, oryzoid, centostecoid, danthonioid, stipoid, residue. The native and exotic floras will be discussed separately. Within the native floras the pooids, danthonioids and stipoids can be said to represent the temperate element of the flora, and the andropogonoids to centostecoids the tropical element. As would be expected the temperate element becomes better represented the more temperate climate of the state becomes, resulting in a high of almost 85 percent for Tasmania to a low of 11.4 percent for the Northern Territory. Even the latter figure appears too high for a state almost wholly within the tropics but this is due to a placing of *Eriachne* amongst the danthonioids whereas the morphology and phytogeography of this genus suggest its affinities probably lie outside the Danthonieae. The significant temperate representation for Western Australia is due to the south-west corner flora, and for Queensland the flora of portion of the MacPherson-Macleay overlap (Burbidge, 1960).

TABLE 12: Numbers of entities in each state and Australia grouped according to the taxonomic groupings in Table 14
(Figures shown as native entities/naturalized exotic entities).

	N.S.W.	Vic.	Tas.	N.T.	S.A.	W.A.	Qld.	Australia
Pooid	110/108	95/105	71/91	1/6	41/76	31/86	31/57	159/153
Andropogonoid	37/11	10/1	4/0	86/4	16/2	59/9	115/14	132/19
Panicoid	92/62	26/26	5/14	102/21	38/20	73/48	167/70	192/87
Aristidoid	31/0	3/0	0/0	31/0	9/0	15/0	61/0	66/0
Chloridoid	70/22	31/9	6/5	137/11	63/11	112/10	168/24	231/31
Arundinoid	2/2	1/1	1/2	4/0	2/2	3/2	7/1	8/3
Bambusoid	0/1	0/0	0/0	1/0	0/0	0/0	3/0	4/1
Oryzoid	2/1	0/1	0/0	3/1	0/0	1/1	3/1	4/2
Centostecoid	0/0	0/0	0/0	0/0	0/0	0/0	3/0	3/0
Danthonioid	40/2	33/3	23/1	44/0	27/4	49/4	43/0	107/5
Stipoid	24/5	30/3	11/2	3/0	36/1	30/1	8/0	62/5
Residue	0/4	0/4	0/3	7/0	0/4	0/7	1/2	8/9
Total	418/218	229/153	121/118	419/43	232/120	373/168	610/169	976/315

TABLE 13: Percentage representation in each state of the entities (grouped according to the taxonomic groupings in Table 14), expressed as a percentage of the total for the state or country.
(Figures shown as entities/native/naturalized exotic entities).

	N.S.W.	Vic.	Tas.	N.T.	S.A.	W.A.	Qld.	Australia
Pooid	26.3/49.5	41.5/68.6	58.7/77.1	0.2/14.0	17.7/63.3	8.3/51.2	5.1/33.7	16.3/47.4
Andropogonoid	8.9/5.1	4.4/0.7	3.3/0	20.5/9.3	6.9/1.7	15.8/5.4	18.9/8.3	13.5/5.9
Panicoid	22.0/28.4	11.4/17.0	4.2/11.9	24.3/48.9	16.4/16.7	19.6/28.6	27.4/41.4	19.7/26.9
Aristidoid	7.4/0	1.3/0	0/0	7.4/0	3.9/0	4.0/0	10.0/0	6.8/0
Chloridoid	19.1/10.1	13.5/5.9	5.0/4.2	32.7/25.6	27.2/9.2	30.0/5.9	27.6/14.2	23.7/12.1
Arundinoid	0.5/0.9	0.4/0.7	0.8/1.7	1.0/0	0.9/1.7	0.8/1.2	1.1/0.6	0.8/0.9
Bambusoid	0/0.5	0/0	0/0	0.2/0	0/0	0/0	0.5/0	0.4/0.3
Oryzoid	0.5/0.5	0/0.7	0/0	0.7/2.3	0/0	0.3/0.6	0.5/0.6	0.4/0.6
Centostecoid	0/0	0/0	0/0	0/0	0/0	0/0	0.5/0	0.3/0
Danthonioid	9.6/0.9	14.4/2.0	16.6/0.8	10.5/0	11.6/3.3	13.1/2.4	7.0/0	11.0/1.5
Stipoid	5.7/2.3	13.1/2.0	9.1/1.7	0.7/0	15.5/0.8	8.0/0.6	1.3/0	6.4/1.5
Residue	0/1.8	0/2.6	0/2.5	1.7/0	0/3.3	0/4.2	0.2/1.2	0.8/2.8
TOTAL	100/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100

The tropical element will be discussed mainly with reference to the major groups, namely andropogonoids, panicoids, aristidoids and chloridoids. The andropogonoids have their best percentage representation in Northern Territory (20.5 percent), Queensland (18.9 percent) and Western Australia (15.8 percent); these include areas with a monsoon climate (high summer rain, no winter rain), and the first two, having a greater proportion of their territory influenced by a monsoon climate, have the higher figures. These observations concur with those previously stated for species distribution (Hartley, 1958a). The panicoids are best represented in Queensland (27.4 percent), the Northern Territory (24.3 percent), New South Wales (22.0 percent), Western Australia (19.6 percent), and South Australia (16.4 percent). According to Hartley (1958b) this group is best represented at species level in regions of high winter temperatures and high annual rainfall and generally speaking this applies to most of the areas considered. The chloridoids have their best representation in the Northern Territory (32.7 percent), Western Australia (30.0 percent), Queensland (27.6 percent), South Australia (27.2 percent) and New South Wales (19.1 percent) while the aristidoids, which are sometimes linked together with the chloridoids, are best represented in the same states, although in a different order — Queensland (10 percent), Northern Territory (7.4 percent), New South Wales (7.4 percent), Western Australia (4.0 percent), and South Australia (3.9 percent). The distribution of these groups agrees largely with the contention (Hartley and Slater, 1960) that they occur in areas of high aridity, high winter temperatures and summer or non-seasonal rainfall. The Eremean zone, where the chloridoids and aristidoids mainly occur, rates well in all these attributes. The much higher figure for the aristidoids for Queensland than for other states indicates possibly that more species of *Aristida* (the only aristidoid genus) are represented in less arid areas than representatives of the chloridoids in general. The occurrence of certain moisture preferring species of *Aristida* has been shown to exist in South Africa (De Winter, 1965).

When the taxonomic breakup of the exotic flora is examined it is seen that the pooids account for by far the majority of the entities in the temperate states and are even fairly well represented in the tropical states. This results from the high proportion of introductions from Europe since settlement. The panicoids and chloridoids are

TABLE 14: Taxonomic Groupings of Australian Grasses.

Pooid	Agrostideae Aveneae Brachypodieae Bromeae Monermeae Phalarideae Poeae Triticeae
Andropogonoid	Andropogoneae Maydeae
Panicoid	Isachneae Melinideae Paniceae
Aristidoid	Aristideae
Chloridoid	Chlorideae Eragrostideae Leptureae Pappophoreae Spartineae Sporoboleae Zoysieae
Arundinoid	Arundineae Arundinelleae Garnotieae
Bambusoid	Bambuseae Phareae
Oryzoid	Oryzeae
Centostecoid	Centosteceae
Danthonioid	Danthonieae
Stipoid	Stipeae
Residue	Ehrharteae Micraireae Nardeae

These groups are basically those of Clifford and Watson (1977) with the following exceptions. 1. *Chionoachne* (Maydeae) is assigned to the andropogonoids from the (eu-) panicoids. 2. *Notochloe, Plagiochloa (Desmaziera)*, and *Spartochloa* (Poeae), *Microlaena* and *Tetrarrhena* (Phalarideae) are assigned to the pooids from the danthonioids and residue respectively. 3. *Plectrachne* and *Triodia* (Eragrostideae) are assigned to the chloridoids from the danthonioids. 4. *Amphipogon, Diplopogon, Elytrophorus* (Danthonieae) are assigned to the danthonioids from the aristidoids, residue and chloridoids respectively. 5. *Cortaderia* (Arundineae) is assigned to the arundinoids from the danthonioids.

better represented the more tropical the state. Other groupings represented in the states are shown in Figs. 20 to 22.

The genera in Australia with the largest number of entities are listed in order of numerical importance in Table 15, with figures in brackets representing the number of naturalized exotics. If the exotics are taken out the relative positions of some genera are changed somewhat and only 42 of the 56 genera in Table 15 would have 5 or more entities.

TABLE 15: Synopsis of genera with 5 or more entities listed in order of numerical importance. (Naturalized exotics in brackets)

Eragrostis	71	(13)	Bothriochloa	10	(2)
Aristida	64		Cenchrus	10	(8)
Stipa	63	(3)	Cymbopogon	9	
Eriachne	46		Ischaemum	9	
Panicum	46	(14)	Echinopogon	9	
Poa	45	(7)	Agropyron	9	(7)
Triodia	44		Lolium	9	(9)
Danthonia	38	(1)	Phalaris	9	(9)
Digitaria	38	(8)	Enteropogon	8	
Deyeuxia	37		Micraira	8	
Agrostis	28	(5)	Ehrharta	8	(8)
Brachiaria	26	(7)	Hordeum	8	(8)
Bromus	24	(23)	Amphibromus	7	
Paspalidium	23		Schizachyrium	7	
Sorghum	21	(7)	Tetrarrhena	7	
Enneapogon	20		Thaumastochloa	7	
Sporobolus	20	(4)	Leptochloa	7	(1)
Ectrosia	18		Avena	7	(7)
Iseilema	18		Chrysopogon	6	
Setaria	18	(10)	Eriochloa	6	
Plectrachne	16		Heterachne	6	
Echinochloa	15	(8)	Cynodon	6	(3)
Paspalum	15	(10)	Urochloa	6	(6)
Festuca	14	(5)	Brachyachne	5	
Amphipogon	13		Oplismenus	5	
Chloris	12	(5)	Hyparrhenia	5	(3)
Pennisetum	12	(9)	Aira	5	(5)
Dichanthium	10	(1)	Vulpia	5	(5)

The tribes with more than one percent of the total number of entities are listed in order of numerical importance in Table 16. The number of genera in these tribes is also shown in the table, but follows no rigid sequence as tribe position is chosen by the numerical order of the entities. The Paniceae is by far the largest tribe with 21 percent of the total followed by the Eragrostideae and the Andropogoneae with 13.8 percent and 11.3 percent respectively. These three tribes comprise just under half (46.1 percent) of the total. If the tribes are arranged in the order of number of genera the sequence is altered significantly with the Eragrostideae falling from second to fourth place and the Poeae elevated from fifth to third place. The Eragrostideae in fact drop their percentage representation of the total by approximately a half, and this is due to their genera being on average larger than those of the Paniceae and the Andropogoneae. In the Aristideae the figure is 90 percent smaller due to there being only one genus *Aristida* with a large number of species.

Table 17 shows the proportion of native entities to naturalized exotic entities for those tribes with more than one percent of the total number of entities. The tribes are listed in order of the numerical importance of native entities. The sequence of tribes

considering only natives is similar to the sequence of tribes when natives and exotics are considered together (Table 16) for the first four tribes but the sequence after that differs somewhat. The Poeae fall from fifth to eighth position because of the high number of naturalized entities. Three tribes — the Aristideae, the Pappophoreae and the Micraireae are represented only by native entities and four others — the Eragrostideae, the Andropogoneae, the Danthonieae and the Stipeae have more than 85 percent of their totals represented by natives. In conrast, three tribes (Aveneae — 78.4 percent, Triticeae — 83.3 percent, Bromeae — 96 percent) are represented by high proportions of exotic entities.

TABLE 16: Synopsis of the tribes whose entities, both native and naturalized exotic, comprise more than 1 percent of the total number, listed in order of numerical importance, together with the number of genera in each tribe.

TRIBE	NO. OF ENTITIES	PERCENT ENTITIES	NO. OF GENERA	PERCENT GENERA
Paniceae	272	21.0	41	19.5
Eragrostideae	175	13.5	15	7.1
Andropogoneae	147	11.3	37	17.6
Danthonieae	112	8.6	13	6.2
Poeae	100	7.7	17	8.1
Agrostideae	98	7.5	14	6.7
Stipeae	66	5.1	4	1.9
Aristideae	64	4.9	1	0.5
Chlorideae	40	3.1	9	4.3
Aveneae	37	2.9	12	5.7
Phalarideae	25	1.9	5	2.4
Triticeae	24	1.8	5	2.4
Bromeae	24	1.8	1	0.5
Sporoboleae	21	1.6	2	1.0
Pappophoreae	20	1.5	1	0.5

TABLE 17: Synopsis of the tribes with more than 1 percent of the total number of entities showing the proportion of native and naturalized exotic entities within each tribe, the tribes listed in order of numerical importance of the native entities.

TRIBE	NO. OF NATIVE ENTITIES	PERCENT NATIVE ENTITIES	NO. OF NATURALIZED EXOTIC ENTITIES	PERCENT OF NATURALIZED EXOTIC ENTITIES
Paniceae	187	68.8	85	31.2
Eragrostideae	154	88.0	21	12.0
Andropogoneae	130	88.4	17	11.6
Danthonieae	107	95.5	5	4.5
Agrostideae	76	77.6	22	22.4
Aristideae	64	100.0	0	0.0
Stipeae	61	92.4	5	7.6
Poeae	55	55.0	45	45.0
Chlorideae	30	75.0	10	25.0
Pappophoreae	20	100.0	0	0.0
Sporoboleae	16	76.2	5	23.8
Phalarideae	15	60.0	10	40.0
Aveneae	8	21.6	29	78.4
Micraireae	8	100.0	0	0.0
Triticeae	4	16.7	20	83.3
Bromeae	1	4.0	23	96.0

Records are being constantly added to and corrections made to the Australian check-list and since publication a few pages of addenda and corrigenda have accumulated. However, the figures given in this analysis strictly pertain to the contents of the list as published and as such they are, following the check-list, of a preliminary nature and will be updated when the taxonomy has been more thoroughly researched.

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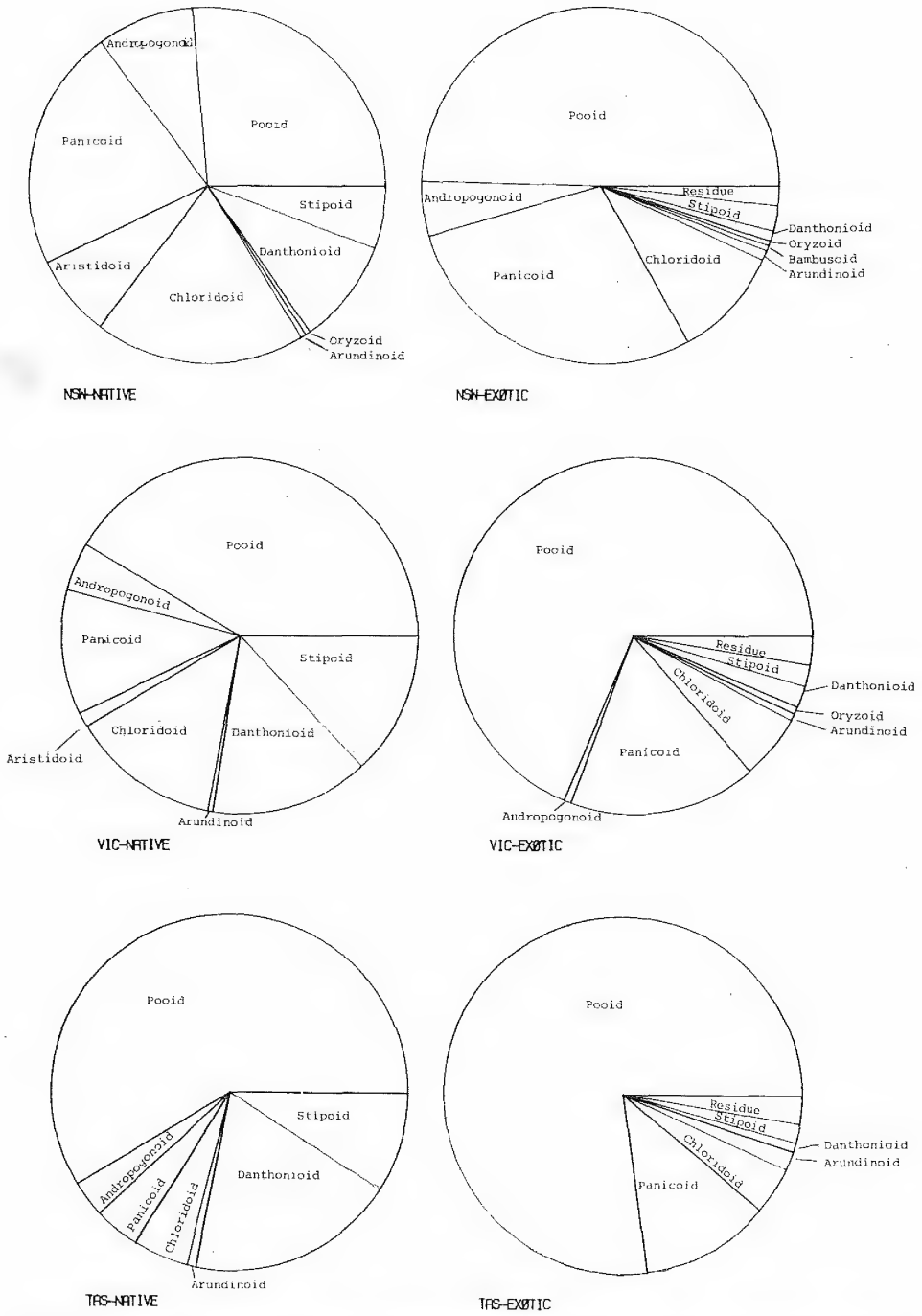

Figure 20. Proportional representation of native and naturalized exotic taxonomic groupings of grasses for New South Wales, Victoria and Tasmania.

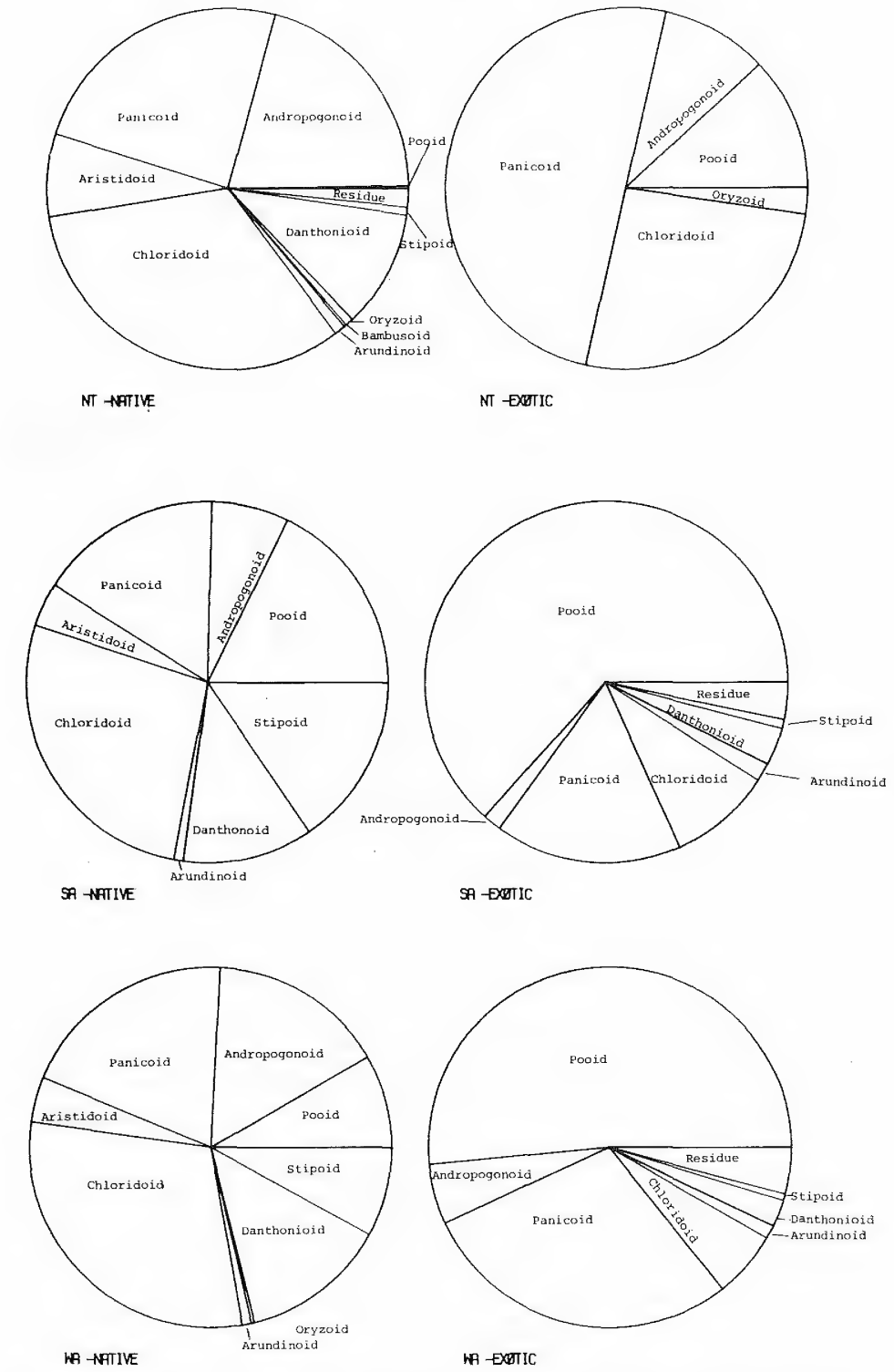

Figure 21. Proportional representation of native and naturalized exotic taxonomic groupings of grasses for Northern Territory, South Australia and Western Australia.

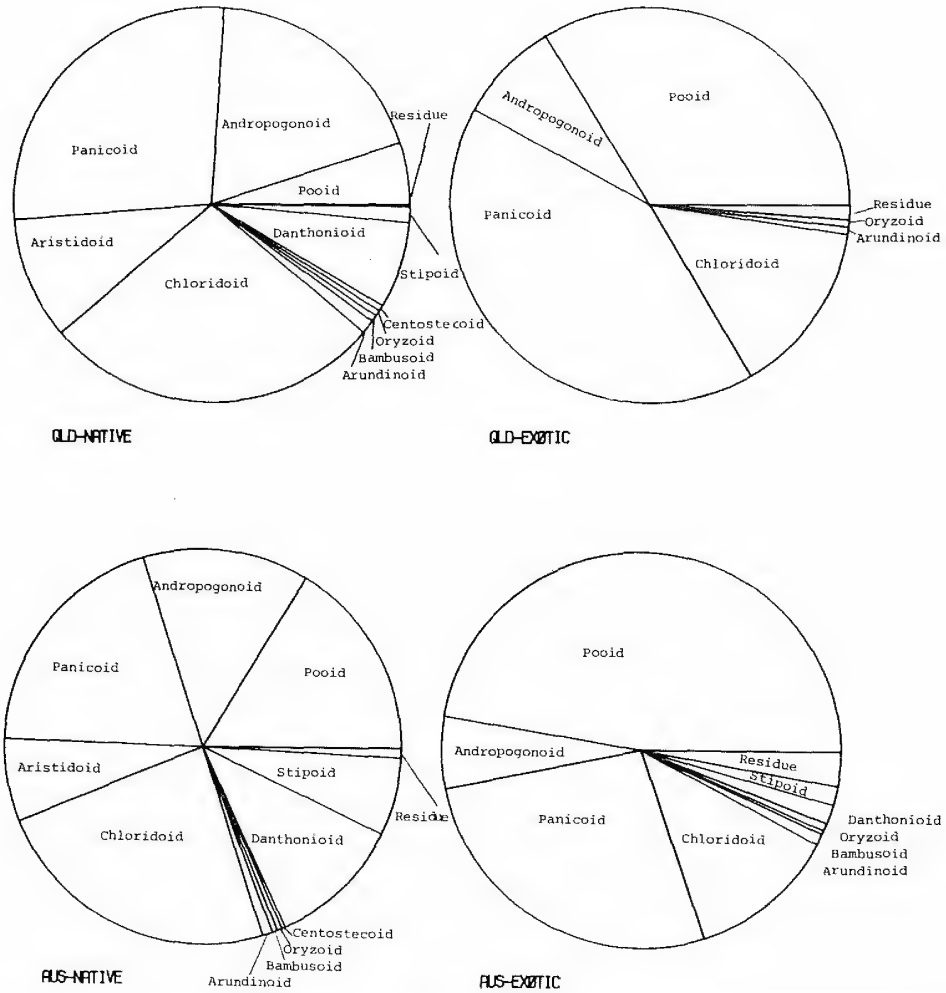

Figure 22. Proportional representation of native and naturalized exotic taxonomic groupings of grasses for Queensland and Australia.